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Mr. Mike Monasmith
Senior Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Hidden Hills Solar Energy Generating System
California Energy Commission Preliminary Staff Assessment
Comments by The Nature Conservancy on Water Supply Assessment

Dear Mr. Monasmith,

The Nature Conservancy is a worldwide conservation organization devoted to conserving the lands and waters on which all life depends. To help reduce adverse effects of impending climate change and meet the State of California's Renewable Portfolio Standard, The Nature Conservancy supports significantly increasing renewable energy generation and transmission. We believe that we can both meet the state's goals for renewable energy production and protect desert species, communities, and ecosystems.

Our organization has been directly involved in the federal and state solar development siting and environmental review processes. The Nature Conservancy's role has focused on encouraging siting of large solar facilities in locations that are both economically sound and compatible with retaining the desert's vital ecological resources, including groundwater that supplies critical imperiled desert springs and wetlands.

Since the early 1970's, The Nature Conservancy has pursued conservation of the uniquely rich and fragile aquatic and riparian systems in the bi-state Amargosa basin. This region is home to more endemic, rare and listed species than any other area of similar size in the continental U.S. It depends almost entirely on perennial groundwater flow to support both its natural and human communities. Protection of groundwater resources is thus the paramount concern for The Nature Conservancy --as well as for federal and state resource agencies and local residents.

The proposed Hidden Hills Solar Energy Generating System (HHSEGS) plants propose to pump groundwater from aquifers in Pahrump Valley, within the Death Valley regional groundwater flow system. We commend Bright Source for employing dry cooling technology and otherwise agreeing to reduce water use to low levels, an especially significant effort, given the amount of power that will be produced by the planned Hidden Hills plants. However, additional pumping, even of small amounts of groundwater, from already stressed desert groundwater basins such as the Pahrump Valley Groundwater Basin (PVGB), where the HHSEGS site is located, can lower critical groundwater levels and adversely affect springs, seeps and wetlands, protected species, as well as other water dependent resources and domestic and municipal water supplies in the area. Reductions of even a foot in groundwater levels, for example, can cause losses and severe declines of aquatic and riparian species such as spring snails, voles, and desert fishes found nowhere else in the world[1].

The Pahrump Valley alluvial and deeper carbonate aquifers are nested within the Death Valley regional groundwater flow system. These aquifers supply water to local springs, mesquite woodlands and other groundwater dependent vegetation, as well as local residential wells. These aquifers are also thought to be linked to, and, after an uncertain transit time, to supply water to the Amargosa River and its vital spring tributaries in the Tecopa and Shoshone California area[2].

The hydrogeology in this portion of the Death Valley regional flow system is not well known. The US Geological Survey (USGS) has done the most extensive work in the region. USGS has constructed a regional groundwater flow model that, based on limited data for this southern portion of the flow system, predicts that precipitation high in the Spring Mountains in Nevada enters the groundwater system there and flows southwest as groundwater into California, beneath and through the Pahrump Basin, under the Nopah Range, and eventually makes its way into the Wild and Scenic Amargosa River and its stream, spring and seep tributaries. The California Energy Commission (CEC) Preliminary Staff Assessment (PSA) Water Supply (WS) analysis references this understanding stating that, based on local gradients, "the basin-fill in Pahrump discharges through most of the Nopah Range." PSA WS at 4.15-11.

However, because the hydrogeology in this portion of the Amargosa is particularly complex and poorly understood, a collaboration between the USGS, the Bureau of Land Management (in both California and Nevada), Inyo County (prospectively), The Nature Conservancy, and the Amargosa Conservancy is funding a series of studies to probe and then model, in fine scale, the subsurface natural "plumbing" of this portion of the Death Valley flow system. These studies are ongoing, and are not yet fully funded. Final results are approximately five years away[3].

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[1] The Devil's Hole pupfish, while a unique example, demonstrates that water level declines of even inches can cause significant negative impacts to protected species.

[2] The CEC PSA water supply analysis agrees that HHSEGS proposed pumping and the Amargosa system are linked, but discounts the effects of the pumping based on hypotheses about time and distance. We believe the effects cannot be so dismissed (see Attachment 1), and we propose below reasons why this linkage is important and steps to ensure that adverse effects on the Amargosa River and its rich ecological communities will not occur.

[3] A proposed program of studies has been prepared by the USGS and is available from that agency's Henderson, NV office. The goal is to develop an adequate understanding of the hydrology and populate a fine-scale groundwater flow model that can be used to predict the effects of pumping and other stresses on the system.

The HHSEGS applicant proposes to drill six new wells within the project's boundaries. These wells would be drilled into the Pahrump Valley alluvial aquifer to depths and in locations not yet finally specified. The wells would be used to extract a total of 288 acre feet of water per year during an approximate three year (29 month) construction period, followed by 140 acre feet per year during an assumed 30 year initial operating life. [4]

The CEC's PSA water supply analysis concludes that three conditions require mitigation to address the likely adverse effects of HHSEGS groundwater use, and proposes monitoring and mitigation requirements to compensate for the 1) exacerbation of overdraft conditions in the Pahrump Valley Groundwater Basin, 2) water level declines potentially affecting the Stump Springs BLM ACEC and other groundwater-dependent vegetation, and 3) lowering of water levels in local domestic wells. While the PSA rejects compensation for effects on the Amargosa River and its tributaries, the PSA WS would require a single offsite monitoring well in the direction of the Nopah Range and California Valley to detect future effects on the Amargosa.

The effects of the proposed HHSEGS pumping on local as well as regional groundwater dependent resources are remarkably indeterminate, and predictions of long term effects exceedingly unreliable. The applicant asserts, based on a truncated 4½ day aquifer performance test (APT, or pump test) and the use of a simplified groundwater model that HHSEGS groundwater pumping will not cause significant effects beyond the boundaries of the project site over 30 years. [5]

The CEC PSA critically reviewed the applicant's conclusions based on the abbreviated pump test (Water Supply Assessment, Appendix A). The Nature Conservancy also contracted for a summary review of that test, the applicant's model and the CEC PSA water supply analysis by an independent hydrological consultant, Johnson Wright, Inc., This review is included as Attachment 1. The Johnson Wright analysis questions the validity of the applicant's conclusions based on the test and modeling results. The admitted deficiencies in the applicant's groundwater model and aquifer test dramatically underscore the nearly total absence of data and consequent lack of science-based understanding of what

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[4] The applicant's power tower technology uses much less groundwater than parabolic mirror facilities, but more than photovoltaic facilities generating equivalent amounts of electrical energy.

[5] Two other prior pump tests were conducted that resulted in widely varying transmissivity values. Raw data from those tests were not made available, nor, based on confidentialty issues, were well logs from the limited number of local wells that CEC staff and applicant may have used their analyses. Applicant apparently made limited use of these two previous pump tests, and it is difficult to determine the extent to which publicly unavailable well log or water level data was used by the CEC or Applicant. We believe that any reliance on undisclosed or unavailable information is inappropriate in reaching conclusions about the effects of groundwater use.

direction and how far and fast the HHSEGS pumping cone of depression will propagate and how the withdrawals will affect the regional water balance.[6]

The Johnson Wright review included consideration of the PSA Water Supply analysis and the most recent presentation by CardnoEntrix on behalf of Applicant at the June 14th workshop in Pahrump. That review emphasizes that the CardnoEntrix and CEC PSA conclusions on the effects of proposed groundwater pumping based on such limited information are clearly not warranted.

The PSA correctly notes that the proposed HHSEGS pumping would represent a relatively modest fraction of existing groundwater extraction from the Pahrump Valley Groundwater Basin, and a quite small fraction of outstanding water rights in the basin in Nevada.[7] However, pumping from the basin exceeded sustainable levels for decades, and water levels recorded in wells across the entire Pahrump Valley Basin already show a sustained decline over recent decades.

Beyond the ongoing regional water level declines, other factors make the HHSEGS pumping significant from an ecological and groundwater mitigation perspective:

- The HHSEGS is only the first of a series of likely solar facilities that would be dependent on pumping groundwater from the basin—including another pending application by Bright Source for a power tower plant named Sandy Valley, but actually located in the southern Pahrump Basin.
- Unlike agricultural water use, solar water use is "hard"— in the sense that all of the water will be consumptively and steadily used, very likely for periods of many decades, perhaps centuries, beyond the initial 30 year operations window.
- While there has been considerable pumping from the northern Pahrump Valley basin in Nevada, there have apparently been only a handful of wells drilled and modest quantities of water extracted from aquifers in the

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[6] As Applicant's groundwater expert report observes: "Typically, several hydraulic aquifer coefficients and parameters are required when creating a groundwater model. These parameters include transmissivity, storage, specific yield, boundary conditions such as leakance, aquifer thickness, recharge, and depth of the pumping wells. For this site only an approximate measurement of transmissivity is available. This lack of detailed aquifer property information constrains the modeling approach that can be employed to only a simplified model package that assumes homogeneous aquifer properties." HHSEGS AFC , Appendix 5-15G at 3.0.

[7] The project will average 167 acre feet per year, including the construction period pumping. Estimated pumping from the basin is 13,000+/- acre feet year. Outstanding water rights in the basin in Nevada , including rights that attached to approved but unbuilt residential lots, probably exceeds 70,000 acre feet.

southern portion of the basin in either California or Nevada[8], accordingly, information about the effects of pumping on ecological resources and other water users in this relatively undeveloped portion of basin is notably sparse.

- Finally, pumping to support solar development is a new use of groundwater, and, as such, is subject to limitations based on the priority of the Amargosa Wild and Scenic River designation.

The Nature Conservancy believes there is justification for considering water use by this facility as essentially permanent; as a result, we recommend analyzing the effects of project pumping over a much longer period. The PSA analysis does not adequately take into account potential long-term consequences of the HHSEGS pumping and that of other cumulative groundwater uses in the Pahrump Valley[9]. We believe that the PSA analysis should be extended using assumptions that the HHSEGS pumping will be continued for at least 100 years, that effects will propagate over 200 years or more, and that the effects of additional PVGB groundwater pumpers, including, but not limited to, the facilities listed in the PSA, should be added to the analysis to provide better approximation of the cumulative effects of this facility's pumping combined with that of other reasonably probable water users.

This analysis of longer-term impacts is critical and justified because adverse effects from groundwater withdrawal can take a very long time to propagate through to distant springs and water dependent resources, even following the cessation of pumping. By the time effects are noticed through monitoring, it is often far too late to restore the health of these resources. [10]

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[8] The PSAWS analysis of effects is in fact based upon bifurcating the PVG Basin into north and south sub basins. WS at 4.15-11 et seq. As noted, water levels in the entire basin have been in decline for decades, with decline rates in the southern portion slower than in the north (~.25 ft/yr/ vs ~1 ft/yr), where agricultural pumping and residential wells have been concentrated.

[9] Note that in the EIS analysis of the effects of pumping by the Solar Millennium facility in Amargosa Valley NV, the time period considered was 200 years. See: Amargosa Farm Road Solar Project Final EIS, (NVN-084359), Volume II, Appendix B--Groundwater Modeling Report: http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/energy/proposed_solar_millenium.html

[10] This is the reason, for example, that the Nevada State Engineer (SE) and BLM, in the context of the approval of the Southern Nevada Water Authority (SNWA) requested permits to pump groundwater from aquifers in rural Nevada counties and pipe it to Las Vegas analyzed the effects of groundwater pumping over more than 200 years, based on well documented groundwater flow models. The SE has approved only a portion of the SNWA's requested pumping, requiring, in essence, a very long term aquifer test prior to allowing additional pumping, and providing that pumping can be halted in the event that adverse effects are noted. See BLM-- Clark, Lincoln, and White Pine Counties Groundwater Development Project Draft EIS, Volume 1A, Chapter 3.3 (water resources) June 10, 2011; http://www.blm.gov/nv/st/en/prog/planning/groundwater_projects/snwa_groundwater_project.html. See, also, a short paper by John Brehehoeft at http://aquadoc.typepad.com/files/groundwater-monitoringfor-mitigation_-will-it-work.pdf , and The Nature Conservancy's critical comments on the BLM's draft EIS, dated September 16, 2011, included in public comments section at http://www.blm.gov/nv/st/en/prog/planning/groundwater_projects/snwa_groundwater_project/draft_eis_public_comments.html.

Placed in a cumulative and long run perspective, the HHSEGS pumping potentially will initiate very significant new burdens on this segment of the regional flow system and its dependent springs and ecological communities – including Stump Spring, nearby mesquite dune vegetation, and the Wild and Scenic Amargosa River and its protected resources[11].

The Nature Conservancy believes that the CEC staff analysis of effects is about as thorough and theoretically correct as possible under the prevailing factual circumstances, but, given the almost total lack of understanding of local hydrology and the long-term effects of pumping in this desert system, the PSA conditions provide insufficient protection for high value and unique protected ecological resources.

The monitoring and mitigation steps outlined in the PSA represent a good start. However, we believe that the program must be augmented to more accurately predict, and more quickly detect and compensate for possible harm in the face of significant long-term hydrologic uncertainties. The high level of uncertainty warrants a very conservative approach, imposing reasonable but clear and effective conditions that would halt HHSEGS pumping if adverse effects are likely. Accordingly, we have the following recommendations.

Monitoring

Given the lack of information about the effects of pumping from the Pahrump Valley aquifer in the Hidden Hills location on local and distant resources, a well-designed monitoring program, including an adequate number of properly placed monitoring wells and enforceable and public reporting requirements, is especially critical. Condition WS-8 in the PSA states that the monitoring network "protects areas that maybe within the influence of project pumping during the project life." We believe that the intended design of the network should be extended to areas or resources that may be influenced by project pumping well beyond the project period and for a minimum of 100 years, given that operations at the HHSEGS facilities are almost certain to continue well beyond the first licensing period. It is simply unrealistic to expect that renewal of the plant's operating franchise would be withdrawn three decades hence, even if severe groundwater problems were encountered.

The PSA WS recommends requiring the applicant to drill and periodically sample water quality and levels in a minimum of 10 monitoring wells. We support requiring an array of monitoring wells located in sites selected as best for detecting offsite

11 An excellent summary of the Amargosa River system's ecological resources is contained in the Biological Resources section of the PSA at page 4.2-43 et seq. While neither the river nor any of its tributary springs are shown as being located within the unrealistically uniform concentric drawdown isopleths in the PSA WS Figure 23, several important springs are shown to be within 5000 meters of the outer ring and many more within 2-3 miles.

effects from HHSEGS pumping and other groundwater withdrawals on key ecological resources, drilled to at least the same depths as HHSEGS production wells and equipped with continuous recording devices. However, we recommend that additional wells be required, that well locations be more clearly specified in the final staff assessment, that all drilling logs and other data on well construction, testing, and performance be made public.

We also recommend that applicant conduct at least one additional reasonable length pump test to supplement the results of the initial truncated test, using newly drilled production and monitoring wells. This additional pre-construction pump testing is warranted because of the limitations of the recent aquifer performance test and accompanying model, and the lack of geological and aquifer data in the area.

Conducting at least one well-designed aquifer performance test after installation of one or more planned production wells and several associated monitoring wells--prior to the commencement of construction and permanent installation of the rest of the wells--would provide the applicant and the CEC with valuable data about how to site other wells and whether the initial assumptions about the aquifer configuration and the absence of off-site drawdown were correct.

Although the terms of applicant's lease have not been revealed, it seems reasonable that additional wells could be drilled this summer (2012) and tested prior to the Commission's issuance of final Conditions of Certification. Review of the aquifer testing results can then be used to confirm whether the applicant's initial assumptions were correct; if not, the plan and CEC's Conditions for Approval should be appropriately revised. We recommend that, as in the case of other required pre-approval resource investigations (e.g., biological, cultural), gathering critical information about effects on the groundwater resource should be done before approvals are issued.

Further, The Nature Conservancy recommends that the CEC require a total of three offsite monitoring wells (i.e. adding 2 wells) to the southwest of the HHSEGS site to detect possible effects on the Amargosa River and its protected resources. In particular, these wells should be designed to determine levels, direction, and flow in the alluvial aquifer and also to probe whether there is communication between the alluvial aquifer and the regional carbonate aquifer. If significant drawdown is detected or carbonate/alluvial aquifer communication is established, conditions on project pumping should be specified.

Additionally, because of the intense public interest in groundwater issues, WS-9 should provide that all of the monitoring wells should include continuous data logging and recording devices and that the raw data and all reports be promptly placed on a public CEC website .

Mitigation

TNC applauds the PSA approach to mitigation—requiring both permanent reduction in water use in the Pahrump Valley Groundwater Basin and monitoring-based triggers requiring reduction or cessation of pumping occasioned by adverse effects on ecological resources. However, we believe that these mitigation measures need to be clarified and strengthened.

Reductions in Basin Groundwater Use

The Water Use Offset plan (WS -1) requires the applicant to submit a Water Supply Plan that outlines how a total of 4900 acre feet of water, or 163 acre feet per year over the 30 year life of the project, will be replaced through as yet unidentified "activities." The applicant's plan must be approved by the CPM prior to construction or well operations. We support this plan approval condition; moreover, because of its importance in determining the adequacy of groundwater mitigation, we recommend that the complete plan should be submitted prior to and included with the final staff assessment, and be subject to public review prior to its approval by the Commission.

We recommend that WS-1 be interpreted to require actual, steady, contemporaneous reductions in PVGB pumping equivalent to the pumping by HHSEGS, we also strongly recommend replacement of groundwater use at a ratio of greater than 1:1[12], for several reasons:

- Given the severe over-allocation of water rights in the basin (65,000+ acre feet allocated versus 12,000-19,000 acre feet of perennial yield) it is unclear whether the retirement of even senior, active and historically exercised water rights will be effective to reduce water use over a 30-year period. This fact, in itself, warrants acquisition and retirement of water rights well in excess of project pumping rates.

- Little pumping from wells in the southern section of the basin has occurred in the past. Most of the active water rights that could be acquired by the applicant for compensation are apparently located in the northern section of the basin. Long-term water levels have declined in the southern area, but only about a quarter as rapidly as in the north, but presumably as a result of the propagation of pumping effects from north to south in the PVGB. The estimated average rate of water level drop is 0.25 foot per year in the south vs 1.0 foot per year in the north. Roughly, then, if acquisition of northern basin water rights are to be permissible compensation, our recommendation is that acquired rights should be at a 4:1 ratio to project pumping to

[12] Applicant's technical report originally committed to acquire up to 400 acre feet for mitigation, a commitment which was then withdrawn as an error. Applicant is now apparently committed to offset its water usage, and has listed a number of possible options, many of which would not represent permanent retirement of active water rights. See Applicant's Data Responses 1-A, ##s 39 and 40 at pp 33-34.

effectively compensate for long term storage reductions in the southern portion of the basin.

- If, as seems likely, the water rights proposed for acquisition are agricultural rights, the relative certainty of pumping (hardness of the water use) for the solar facility as compared with agricultural use further justifies requiring a compensation ratio that is significantly greater than 1:1.

We also encourage the CEC to provide more clarity around how the PSA compensatory mitigation obligation would work in practice. The PSA appears to allow the applicant to acquire either an annual 167 acre feet/year or a gross quantity of water rights (4,900 acre feet) with no specified time period for the acquisition. While we do not think the PSA contemplates this result, the mitigation obligation theoretically could be satisfied, as an extreme example, by a single-year lease of 4,900 acre feet of water, promised to be executed at the end of the 30-year operating period. Moreover, the mitigation obligation is framed as "one or more activities," which would apparently not compel the applicant to actually acquire and retire active, senior water rights in the PVG Basin[13].

We recommend that the mitigation obligation be stated categorically to require contemporaneous acquisition and permanent retirement of actively used, senior water rights in the Pahrump Valley groundwater basin of four times the projected annual average project pumping rates of 167 acre feet/year— a total of 668 acre feet/year.

Triggers for reduction in water use by HHSEGs

We strongly support the PSA requirement to reduce or cease groundwater pumping in the event that adverse effects to ecological resources are occasioned by HHSEGS water use. This requirement is of cardinal importance given the lack of information about the hydrology of the area and the importance of the potentially affected ecological resources.

However, we object to the specific trigger conditions proposed in PSA's biological resources (BIO-23 and 24) and water supply (WS-8) sections as Conditions for Certification, because these Conditions will not adequately protect groundwater-dependent ecological resources before they are likely to experience significant harm.

[13] Several of the compensatory mitigation options listed by Applicant in its data responses (see footnote 12, above) would not require acquisition and permanent retirement of water rights. In light of the gross over-allocation of water rights in the Pahrump Valley basin and the fact that Applicant's use of water is very likely to be perpetual, if mitigation is not limited to acquisition and permanent retirement of active, senior water rights in multiples of proposed use, further and more rapid declines in the southern basin water levels—and the Amargosa system-- are likely.

This statement from the Biological Resources section of the PSA (4.2-170) reveals the PSA's sound underlying rationale for imposing adaptive action in the event of predicted adverse effects on protected ecological communities:

> *Given the cumulative concerns..., combined with the limited quantity and reliability of the data, and the ecological significance and sensitivity of the resources at risk, a conservative approach must be applied that combines long-term groundwater elevation monitoring and monitoring the health of the mesquite, with clear and detailed triggers for adaptive action if **impending** impacts are detected. (emphasis added).*

BIO 24 states:

> *"Thresholds for remedial action... are designed to **avoid impacts to the mesquite woodlands and other groundwater-dependent ecosystems (GDE) near the project before they result in a loss of resources,** or a significant impact to habitat functions and values." (emphasis added)*

However, the PSA's trigger conditions will not satisfy these goals. Rather than averting the harmful effects on the ecologically important Stump Springs and Pahrump Valley mesquite Metapatch before resources are lost, the PSA conditions would essentially require proof of a 20% decline in the health of the baseline resource, plus a showing of a statistically significant water level decline, combined with demonstrations that the declines are attributable to the applicant's activities and cannot be attributed to regional drought conditions or other pumping. This is an unwieldy and unworkably difficult test; and, if it were proposed to be invoked to limit pumping, protracted litigation would almost certainly ensue.

Despite a very detailed, sophisticated proposal in the biological resources analysis that would be used determine when the 20% effects level is reached, this trigger would not provide the intended result of avoiding adverse impacts. Once the 20% level is reached, irreversible harm is likely inevitable because of the usual nature of groundwater systems. That is, by the time adverse effects are first detected in resources remote from the pumping location, the time lag to recovery after pumping ceases will cause further and prolonged declines in water levels before they begin to recover, resulting in permanent loss of habitat and dependent ecological resources. Lastly, there are significant difficulties in establishing that decreases in water levels are not due to drought or other extraneous factors, including other groundwater pumping.

We recommend that the CEC establish clearer and more effective trigger conditions. Given that we lack understanding of the local and regional hydrology and an accompanying detailed groundwater flow model that could be used to predict and avoid adverse impacts, the only reasonable alternative is to set very conservative trigger conditions. We recommend that Applicant cease groundwater pumping when specified, measurable water level declines are detected in offsite groundwater monitoring wells, sited to predict whether the cone of depression caused by HHSEGS pumping is moving toward Stump Spring or other ecologically protected resources, including the Amargosa River. The currently proposed tripartite test, which requires that the agency show offsite water level declines, plus adverse effects on ecological resources, and to exclude other possible reasons for the effects will not protect resources. Most importantly, once a triggering water level decline occurs, applicant should have the burden to establish that any water level declines are wholly caused by drought or other circumstances for which they are not responsible.

We thus advocate permit conditions requiring, once offsite water levels decline or any decline in vegetation health is detected, that the applicant demonstrate that those effects are not the result of their pumping.

We note that this test would be compatible with the applicant's assertions that the effects of its groundwater pumping will not propagate offsite or affect ecological resources.

The Amargosa River

In 2009, a 27-mile perennially flowing reach of the Amargosa River in California was added to the national Wild and Scenic River System, adding inchoate but legally effective federal water rights protections to BLM's previous Area of Critical Environmental Concern. This area of the river and its vital fresh water tributaries support many listed, sensitive and endemic species. The PSA WS analysis states:

> *...the proposed project has the opportunity to reduce groundwater flow that would otherwise be received down-gradient. If this was the case, the project could have the opportunity to capture water that would otherwise flow to the Amargosa River. WS at 4.15-19*

However, the PSA concludes that because "potential impact(s)are ... so far into the future and so distant from the proposed project that it could not be reasonably discerned from other stresses in the regional hydrologic system" (id), "The proposed HHSEGS project would not be expected to have a measurable impact to the Amargosa River or its tributaries. " WS 4.15-1

While minimizing the potential effect of the HHSEGS pumping on the Amargosa, the staff report acknowledges that its analysis is not supported by subsurface data because these data are not available. For this reason it recommends the drilling and monitoring of a single well between the HHSEGS site and the Amargosa River to detect project-induced water level declines in the aquifer between the project site and the river.

We recommend that at least three monitoring wells be required between the project site and the Nopah Range, adequate to determine both water levels in, and effects of pumping on, the alluvial aquifer, as well as whether the alluvial aquifer and deeper carbonate aquifer are in communication[14]. We also recommend that CEC specify mitigation requirements, including pumping cessation or reduction in the event that specified water level declines (greater than one foot) are noted in any of the monitoring wells or other adverse effects are detected.

The Amargosa River is a critically important regional ecological feature. Wild and Scenic River status protects and lends priority to the river's flows over new uses of water that may adversely affect the river and its tributaries. The CEC should ensure that the river, its spring tributaries, and ecological resources are adequately protected by conservative conditions on project groundwater use to avoid adverse effects before they occur. This will require a well- designed monitoring network, development and use of a predictive groundwater model, and adaptive trigger conditions.

Thank you for the opportunity to comment.

Alfredo Gonzalez
Regional Director
South Coast & Deserts

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[14] We have attached a proposal for the location and costs for the three wells prepared by Johnson Wight, Inc., the firm whose principal investigators have done significant hydrology work in this region.

Attachment #1

Date: July 17, 2012

To: Project File – JWI1305

From: Jon Philipp, Andy Zdon

Subject: Summary Memorandum - Review of Hydrogeologic Analysis, Proposed Hidden Hills Solar Electric Generating System Project, Inyo County, California

The following memorandum summarizes three previous documents prepared by Johnson Wright, Inc. (JWI), providing comments on hydrogeologic analyses conducted to evaluate the potential impacts to groundwater of the proposed Hidden Hills Solar Electric Generating System (HHSEGS). Based on the following assessment, the project applicant has not provided the requisite supplemental hydrogeologic knowledge regarding the site or surrounding areas to justify the conclusions its consultants have reached. Little is known about the subsurface in this area, and attempting to make general land management decisions based on "assumed understandings" of the groundwater system in the project area is not appropriate. Moreover, recent investigations in the Amargosa Basin indicate that the conceptual hydrogeologic model for the area may vary considerably from that which has has been long-held. For example, a recently installed monitoring well along the Amargosa River north of Shoshone, California suggests a considerably different relationship between the Amargosa River and groundwater flow beneath it at that point than previously believed. Additional hydrogeologic characterization is clearly needed to support a reasonable analysis of the potential impacts of the proposed project, and to provide the basis for sound land management decision-making. For example, a properly-run and documented aquifer test has not yet been completed at the site and should be conducted. As well, the hydrogeologic investigation conducted thus far has not established (and was not designed to evaluate) a disconnect between project pumping and flow in the federally-designated Amargosa Wild and Scenic River flow system.

Groundwater Modeling – Impact Analysis

As part of the Bright Source Energy August 2011 Application for Certification (AFC) for the Hidden Hills Solar Electric Generation System (HHSEGS), Cardno-Entrix (Entrix) authored two documents both titled 'Groundwater Modeling Technical Memorandum.' These two documents were included in the HHSEGS AFC as Appendix 5.15F (July 12, 2011) and Appendix 5.15G (July 20, 2011). The documents describe the results of a modeling exercise designed to predict the extent of groundwater drawdown in response to a range of potential short and long-term groundwater pumping scenarios at the HHSEGS site. A review of both documents shows that minimal site-specific hydrogeologic information was available, which necessitated the use of a very simplistic groundwater model that does not represent known hydrogeologic conditions (for example the presence of geologic structures such as faults and non-basin fill materials). At the time these documents were written, the applicant's aquifer testing on site-specific wells had not yet been conducted and the results of that testing were not available. The results of previous aquifer testing that were used in the analysis have not been presented and therefore the quality of that work which forms the basis of the analysis cannot be evaluated. There was an absence of site characterization by the applicant prior to the modeling analysis, and modeling was solely based on the sparse existing data for this part of the Pahrump Groundwater Basin. Thus, the results of the modeling have substantial uncertainty and the current model is inadequate as a predictive tool.

In general, the Appendices detail the modeled results of two primary scenarios:

1. The effect on the regional aquifer as a result of the planned pumping of 200 to 280 acre-feet per year (ac-ft/yr) during the two to three year construction period of the HHSEGS facility is detailed in Appendix 5.15F.
2. The effect on the regional aquifer as a result of the planned pumping of 140 ac-ft/yr during the 25 year lifespan of the HHSEGS facility is detailed in Appendix 5.15G.

The primary issue is the technical basis on which the model was built. In Appendix 5.15F, which focuses almost exclusively on modeling results, Entrix states, "The set-up and results of the original model were discussed in a previously submitted technical memorandum (dated July 3, 2011)." This July 3, 2011 memo was not included in the HHSEGS AFC and is not included in the list of documents related to the HHSEGS facility on the California Energy Commission (CEC) website. However, the Appendix 5.15G document does offer more information as to what was apparently relied upon to create the model used in both scenarios.

In Appendix 5.15G, Entrix acknowledges that water for the HHSEGS facility will be pumped from the Basin-Fill aquifer and that, "in the project area, wells of 300-400 feet deep are likely sufficient to provide the required yields for the Project." A 1966 APT conducted in the vicinity of the proposed HHSEGS facility by Geotechnical Consultants estimated aquifer transmissivity to be 7,225 gallons per day per foot (gpd/ft). No additional details of the Geotechnical Consultants APT were included. Another similarly located APT performed in 2003 by Broadbent and Associates estimated the aquifer transmissivity to be 4,675 gpd/ft.

Entrix noted that the short duration of the Broadbent and Associates APT precluded obtaining reliable storage coefficient values or estimating leakance.

Entrix does not mention what model was used to simulate the various pumping scenarios. They understand that "several hydraulic aquifer coefficients and parameter are required when creating a groundwater model." Entrix then acknowledges that "For this site only an approximate measurement of transmissivity is available. This lack of detailed aquifer property information constrains the modeling approach that can be employed to only a simplified model package that assumes homogeneous aquifer properties". For the model, the transmissivity value of 7,225 gpd/ft was used. To represent a "typical semi-confined [aquifer] condition", a storage coefficient of 0.01 was used. The analytical method used for calculating drawdown was Theis (1935), which is a confined aquifer solution. A regional groundwater gradient of 0.01, taken from groundwater surface maps, was applied to the model. In order to account for uncertainty in the one aquifer parameter Entrix had to work with, they ran each model scenario with a transmissivity of 7,225 gpd/ft, followed by runs with half that transmissivity value and with twice that transmissivity value, respectively. The model results can be seen in Appendix 5.15F and Appendix 5.15G in table format and graphically as nearly concentric circles of drawdown around the pumping center-- as would be expected from such a simple modeling approach.

The inherent simplicity of the model employed combined with the absence of site specific data (i.e. the only physical value used in the model was aquifer transmissivity derived from the Geotechnical Consultants APT) disconnects the model results from a reasonable simulation of existing conditions. The lack of site specific information then imposes no reliable constraints on the model; therefore, the model is not useful as a tool for predicting drawdown impacts related to any pumping scenarios.

The most important piece of missing information is the detailed geology under the HHSEGS site to the depth of proposed project production wells (the maximum depth Entrix believes a well would have to be drilled for adequate water to meet project needs is 400 feet, although applicant has recently suggested that deeper wells may be employed). This information could easily be obtained by supplemental drilling and collecting soil core data. Currently, neither the depth of the actual water bearing zone is known , nor if there are multiple water bearing zones. The water bearing zone materials are also unknown. Without APT-derived pumping test data, a primitive site conceptual model could still be prepared based on the soil core information, leading to some better informed assumptions as to what appropriate aquifer coefficients and parameters should be used in an analytical model. **Comments Regarding Aquifer Testing**

The March 2012 document titled 'Long-Term Aquifer Performance Test Report' (APT Report) by Entrix summarizes the design, implementation, analysis and conclusions of an aquifer performance test (APT) conducted at the future site of the HHSEGS. A thorough review of the document has revealed deficiencies in the design, implementation and analysis of the APT that question the conclusions reached by Entrix regarding the proposed HHSEGS long term project pumping impacts. The following paragraphs highlight the deficiencies,and their relevance to the Entrix conclusions.

In general, the biggest deficiency is the lack of a data-based conceptual site model of subsurface conditions. It is important to the proper design of an APT to identify the water bearing zones (aquifers) and the low permeability zones (aquitards) separating them. Entrix has compiled a narrative of regional geologic conditions based on previous investigations around other portions of Pahrump Valley and has made some assumptions as to what they believe geologic conditions are like under the HHSEGS site. In general, Entrix summarizes HHSEGS site conditions as follows:

> The HHSEGS site is underlain by Quaternary sediments, which form the primary water bearing units within the basin. Channel gravels become finer grained upward, becoming mudstone near the top of the sequence. The mudstones are overlain by silt and thin gravel beds. These deposits record a change from a fluvial and lacustrine condition during the most recent glacial cycle to the arid conditions found today (Flynn, et al 2006). The maximum thickness of the alluvium is at least 800 feet (DWR, 1964).

The summary suggests variable subsurface conditions ranging from mudstones, which would likely act as an aquitard, to gravel beds, which would likely act as an aquifer. However, no HHSEGS site specific information has been collected below a depth of 200-feet below ground surface (bgs), which was done during the installation of the observation wells Entrix used for the APT. In short, knowledge was lacking regarding site specific conditions below that depth when the APT was designed, run and analyzed.

The pumping wells used during the APT were wells already in existence on the HHSEGS site, including the Orchard Well and Well #3. Well #3 was evaluated using a down-hole camera. This well was found to be cased to a depth of 790-feet bgs and open hole from 790 to 970-feet bgs, which indicates that; 1) water is being drawn from a depth of 790-feet or greater and 2) the surrounding formation from 790-feet bgs and below is lithified enough to not collapse on itself in the absence of a well screen. The Orchard well was only evaluated for total depth, which remains unknown as the device used to measure total depth was not long enough. Thus, one of the pumping wells has an inlet below 790-feet bgs while the inlet of the other pumped well is unknown. In both cases, the boring logs for the pumped wells were not included in the APT Report, so the assumption is they were not made available to Entrix. Accordingly, geologic conditions in and surrounding the pumping wells are unknown. In contrast to the pumping wells, the observation wells were installed to a shallower depth of 200-feet bgs. With the partial exception of well MW-6, all of the observation wells were screened within clay and silt formations which are generally considered aquitard material rather than aquifer material. In short, the Entrix APT pumping wells are in unknown geologic formations (potentially lithified) and, in the case of the Orchard Well, the pumping inlet is at an unknown depth, while the observation wells are set many hundreds of feet shallower in geologic formations generally more akin to aquitard material.

Entrix encountered several difficulties during the data collection phase of the APT. The most significant was the premature end to the APT when the pumping equipment in Well #3 fell to the bottom of the well. In general, the longer the duration of the APT, the better and more informative the results, as the cone of depression will continue to expand as pumping continues. The foreshortening of the test introduces additional uncertainty to the test results, especially when using the results to make long term predictions related to water availability.

Other issues surrounding the Entrix data collection efforts related to the APT which have to potential to add uncertainty to the APT results include:

1. Something happened to the transducer in pumping Well #3 50 minutes into the test. There is a nearly two hour gap in data collection from 50 minutes into the test to 2 hours and 40 minutes into the test.
2. Manual depth to water measurements in the pumping Orchard Well do not match the data collected by the transducer. At some points, the difference is as much as five feet.
3. It seems as if there were only four data points collected from observation well MW-1 during the first 5 hours and 42 minutes of the test. It also seems that drawdown was 'zeroed' at 5 hours and 42 minutes into the test.
4. It seems as if there was only four data points collected from observation well MW-2 during the first 5 hours and 39 minutes of the test. It also seems that drawdown was 'zeroed' at 5 hours and 39 minutes into the test.
5. There are only two manually collected data points from observation well MW-6 during pumping portion of the APT.

6. A seemingly arbitrary 'zero' point was chosen for the transducer data collected from Stump Springs. Although this method would still show a response in the monitoring well, this is another example of how the field work conducted during the APT varies from standard water resource investigation techniques and adds concern to the data collection efforts. Future aquifer testing should be conducted with independent oversight.

Entrix used the commercially available software package Aqtesolv to analyze their APT data. According to Section 5.2 of the APT Report, Entrix used Aqtesolv to fit each observation well's time vs. drawdown curve "to the appropriate type curve" to determine aquifer properties. Although not explicitly stated, this suggests that multiple solutions were tried until a best fit was encountered. In all cases, the best curve fits were from the family of curves used to describe leaky aquifers: Entrix specifically called out both a Hantush-Jacob solution curve and a Neuman-Witherspoon solution curve for specific data sets. Both of these solutions specifically describe a situation where the aquifer being tested resides beneath another aquifer separated by an aquitard. The solutions take into account water sourced from both the pumped aquifer and from water leaking though the aquitard to the pumped aquifer from the aquifer above.

Despite the fact that the solution curves fit the data generated by the recorders in the observation wells, due to the lack of subsurface information, the geologic situation the solution curves solve for has not been established at the HHSEGS site. It should also be noted that Entrix assumed a 1000-foot aquifer thickness in their solutions, which may be contradictory with the leaky aquifer concept, and suggests the pumping well and the observation wells are all in one continuous water bearing formation. If this situation is true, an unconfined aquifer solution may be more appropriate for the data. Finally, one primary caveat related to the curve fit aquifer solutions is that the pumping well fully penetrates the aquifer and that flow to the pumping well is horizontal. This cannot be true, assuming that Entrix's 1000-foot aquifer thickness is valid, which would introduce additional error to the analysis. In short, there is a lack of information about the local geology or depths to aquifers and aquitards, a significant difference between the depth of the pumping wells and the depth of the observation wells, and a seemingly arbitrary application of aquifer test solution curves and aquifer thickness values.

In summary, there are significant deficiencies related to the design, implementation, and analysis of the APT conducted at the HHSEGS site. The most critical is that there is an absence of knowledge of local geologic and hydrologic conditions from which to design a successful test. Entrix designed their APT with no local knowledge of the subsurface below

200-feet bgs, used pumping wells installed into unknown formations and at unknown depths, and used observation wells that were between 300 and nearly 800 feet vertically offset from the pumping wells, and which does not follow standard practice. Any conclusions drawn from such a test are suspect. Additional concerns regarding the collection of data, the duration of the APT, and the way the data were analyzed only add to the uncertainty of the APT results.

California Energy Commission (CEC) Preliminary Staff Assessment (PSA)

The PSA for the HHSEGS was released by the CEC during May 2012. The Water Supply section of the PSA (Section 4.15) addresses potential impacts on groundwater resources by the proposed HHSEGS, including impacts to the Amargosa River. In the summary of conclusions for the Water Supply section, the PSA states "The proposed HHSEGS project would not be expected to have a measureable impact on the Amargosa River or its tributaries." JWI believes there is an insufficient technical basis to support this statement.

In general, there is a scarcity of data related to the hydrology of the southern Pahrump Valley, California Valley, Chicago Valley and the Amargosa River. Also poorly understood are the groundwater interconnections between these aforementioned areas. Data supplied by the applicant has not increased the base of knowledge.

The applicant has attempted to quantify the effects of direct groundwater impacts related to the proposed pumping at the HHSEGS site via two methods. The first method was the use of a simple analytical groundwater model to show the cone of depression likely resulting from 25 years of project pumping. The available data for use in the model was limited to a value for aquifer transmissivity derived from a 1966 aquifer performance test (APT) conducted near the HHSEGS site. All other aquifer parameters were assumed values. The resulting cone of depression extended into the Nopah Range suggesting impacts might extend into California Valley (which is hydrologically linked to the Amargosa River), but not as far as the Amargosa River itself. The second method used by the applicant was to conduct an APT at the HHSEGS site using two pumping wells and an array of monitoring wells. The results of the applicant's APT suggested that the cone of groundwater depression resulting from 25 years of project pumping might not extend past the HHSEGS site boundaries. As described earlier, these results are suspect based on significant concerns related to the applicant's design, implementation and analysis of their APT. Further, it is not appropriate to use an APT to make long-term conclusions regarding impacts. An APT solely allows for the evaluation of hydraulic characteristics which are then used as input in a subsequent analysis to evaluate long-term impacts. In summary, the applicant's APT and modeling efforts have not added to the understanding of the groundwater flow system at the HHSEGS site or in the surrounding areas.

In order to determine if groundwater pumping at the proposed HHSEGS site might have an impact on the Amargosa River, the PSA used a model similar to the applicant's model to show the possible cone of depression resulting from 30 years of project pumping. Using a range of values for aquifer parameters based on the CEC Staff's best estimates, groundwater surfaces were generated for 30 years of proposed project pumping at the HHSEGS site. The resulting cone of depression extended into both Chicago Valley and California Valley. While these assumed drawdowns did not directly intersect the Amargosa River, the project pumping could potentially affect groundwater levels in these valleys that have a defined connection with the Amargosa River.

The PSA also utilized the existing dataset to make general statements about regional groundwater flow. Regarding regional flow from the HHSEGS site, they state,

> "Although a map of the potentiometric surface constructed from available water level data suggests that groundwater in Pahrump [Valley] has a southwesterly flow direction, limited data is available to suggest that groundwater flow in the southern portion of the Pahrump Valley would discharge at the Amargosa River. Potentiometric contours suggest the possibility that groundwater that could be captured by the proposed HHSEGS site has a flow path that may not intersect the river, but would instead flow to the south."

There is no significant data to support or refute the scenario suggested by the above paragraph. The PSA acknowledges this lack of information in the next paragraph by stating,

> "...that flow from the Pahrump Valley, to Chicago Valley, to the Amargosa River could be limited, based on preliminary geochemistry data (ARM 2011a). Unfortunately very few wells exist in between the proposed project and the Amargosa River, which would help to identify flow paths and potential discharge to the Amargosa River."

The PSA is entirely correct in acknowledging the lack of adequate subsurface data supporting or refuting groundwater flow connections between the HHSEGS site and the Amargosa River through the intervening valleys. Impact(s) to the Amargosa River related to project pumping cannot and should not be discounted.

Finally, the PSA performed a travel time calculation for groundwater flowing between the HHSEGS site and the Amargosa River assuming a direct connection. Assuming a travel distance of 20 miles, a hydraulic conductivity (K) value of 1 foot per day (ft/d), a porosity of 0.2 and a gradient based on the difference in groundwater elevation between the site and the river, the calculated groundwater travel time was over 3,000 years. Increasing K to 15 ft/d reduced the travel time to 214 years. These calculations do not reflect the potential for the actual groundwater flow path between the HHSEGS site and the Amargosa River (assuming it exists) to significantly reduce those travel times. For instance, Willow Creek Wash, located at the southern end of California Valley, is a very narrow canyon filled with very recent and unconsolidated alluvium though which groundwater could potentially travel at much higher velocities than those calculated in the PSA. Additionally, the water flowing in this wash often becomes surface flow in the China Ranch area and often remains so all the way to the confluence with the Wild and Scenic Amargosa River. Both of these flow properties would have the effect of shortening the groundwater travel time from the HHSEGS site to the Amargosa River. Groundwater flow system specifics are not accounted for in the PSA travel time calculations due to lack of data, and thus should not be discounted by assuming "no effect."

More critically, the travel time for a particle of water to reach the Amargosa River from Pahrump Valley has little relationship to hydraulic effects, which can be transmitted nearly instantaneously over long distances within a confined aquifer. The result is that an estimate of travel time from Pahrump Valley is not a conservative assessment of potential effects to the Amargosa River.

In conclusion, the applicant has not substantially added to the needed body of hydrogeologic knowledge regarding the site or the surrounding areas. Additionally, the CEC PSA forms conclusions about the potential for the HHSEGS project to impact flows in the Amargosa River based on an inadequate base of knowledge about the local and regional flow systems. Falling back on 'assumed understandings' about the system is not appropriate based on recent drilling along the Amargosa River which altered 50+ years of one 'assumed understanding' regarding the relationship between the Amargosa River and the underlying groundwater. Ultimately, additional data points, most significantly monitoring wells both at the HHSEGS site and along suspected flow paths to the Amargosa River, will be needed to answer the question of connectivity.